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RECORDING SHEET AND ITS MANUFACTURING METHOD  
[Kiroku sheet oyobi sono seiho]

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Claims

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1. A recording sheet characterized by the fact that a recording layer with an insolubilized compound by the insolubilization of a water-soluble polymer compound constituted from the repeating unit represented of the following general formula (1) as the major component is provided.

[Structure 1]

— $\text{C}_2\text{H}_4\text{XAR}_1\text{O}$ —

(1)

[In formula (1), A is a unit constituted by the repeating unit of  $\text{C}_2\text{H}_4\text{XAR}_1\text{O}$ — (where  $-(\text{CH}_2\text{CH}_2\text{O})-$  mentioned above in A is present at at least 70 wt%, the number of repetitions is a positive number, the number of repetitions of  $-(\text{CH}_2\text{CHR}_1\text{O})-$  is 0 or a positive number, and  $R_1$  is a hydrocarbon group.). X is the residual group of an organic compound having two active hydrogen groups and  $R_2$  is a dicarboxylic acid compound residual group or a residual group of a diisocyanate compound.]

2. The recording sheet described in Claim 1, characterized by the fact that the water-soluble polymer compound constituted from the repeating unit represented by general formula (1) given above is a substance with a weight-average molecular weight of at least 50,000 by the reaction of (A) and (B) in the following.

(A) A polyalkylene oxide compound produced by the addition polymerization of an alkylene oxide with ethylene oxide as a major component in an organic compound having two active hydrogen groups.  
(B) At least one of a dicarboxylic acid compound and a diisocyanate compound.

3. A method for the manufacture of the recording sheet characterized by the fact that it is provided with a process for the preparation of a sheet-shaped base material and a process for the preparation of a recording layer-forming material with a water-soluble polymer compound constituted from the repeating

\* [Numbers in right margin indicate pagination of the original text.]

unit represented by the following general formula (1) as the major component, a recording layer consisting of the recording layer-forming material is formed on the sheet-shaped base material side mentioned above, and at least one of electrodissociating radiation rays and active light is radiated on the recording layer side mentioned above.

[Structure 2]



[In the formula (1), A is a unit constituted by the repeating unit of  $\text{---} \left( \text{CH}_2 \text{---} \overset{\text{R}_1}{\underset{\text{CHO}}{\text{C}}} \text{---} \right) \text{---}$  (where  $-(\text{CH}_2\text{CH}_2\text{O})-$  mentioned above in A is present at at least 70 wt%, the number of repetitions is a positive number, the number of repetitions of  $-(\text{CH}_2\text{CHR}_1\text{O})-$  is 0 or a positive number, and  $\text{R}_1$  is a hydrocarbon group.). X is the residual group of the organic compound having two active hydrogen groups and  $\text{R}_2$  is a dicarboxylic acid compound residual group or a residual group of a diisocyanate compound.].

4. A method for the manufacture of the recording sheet described in Claim 3, characterized by the fact that the water-soluble polymer compound constituted from the repeating unit represented by the general formula (1) given above is a substance with a weight-average molecular weight of at least 50,000 by the reaction of (A) and (B) in the following.

- (A) A polyalkylene oxide compound produced by the addition polymerization of an alkylene oxide with ethylene oxide as a major component in an organic compound having two active hydrogen groups.
- (B) At least one of a dicarboxylic acid compound and a diisocyanate compound.

## Detailed explanation of the invention

[0001]

Industrial application field

The present invention relates to a recording sheet for use in the inkjet mode or other printing and copying uses.

[0002]

Prior art

In general, the transfer use recording sheet for printing, copying and so on by the inkjet mode is constituted from the substrate material and the recording layer provided on the surface of the substrate material. As the recording sheet layer formation use material mentioned above, for example, a starch, a polyvinyl alcohol, a cellulose type water-soluble compound, a natural water-soluble gum, a polyacrylamide, a polyacrylic acid, a polyethylene oxide, a polyvinylpyrrolidone and so on can be mentioned. Printing and copying are carried out by the absorption of a water-soluble ink in the recording layer formed by using the recording sheet layer-forming material mentioned above.

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[0003]

Problems to be solved by the invention

However, for the recording layers formed from the conventional recording sheet layer-forming materials, because of poor wetting of multiple color inks and poor absorption characteristics, there are cases in which color mixing or dispersion of inks of different colors and dirtying due to flowing out occur. Furthermore, under high humidity, problems like the soaking of the printed picture surface and

the thickening of the picture surface occur. The actual situation is that a satisfactory recording sheet has not been obtained yet.

[0004]

The present invention, in view of the above, has an objective of supplying a recording sheet that has a vivid and high density printed picture surface, is free from the soaking of the printed picture surface even under a high humidity atmosphere or the thickening of the surface, and does not flow off even by contacting with water.

[0005]

Means to solve the problems

In order to achieve the objective mentioned above, the recording sheet of the present invention has the first objective of a recording sheet provided with an insolubilized compound by the insolubilization of a water-soluble polymer compound constituted from the repeating unit represented by the following general formula (1) as the major component.

[Structure 3]

— $\text{A} \times \text{R}_2$ —

(1)

[In the formula (1), A is a unit constituted by the repeating unit of  $\text{CH}_2\overset{\text{R}_1}{\underset{\text{CHO}}{\text{C}}}—$  (where  $—(\text{CH}_2\text{CH}_2\text{O})-$  mentioned above in A is present at at least 70 wt%, the number of repetitions is a positive number, the number of repetitions of  $—(\text{CH}_2\text{CHR}_1\text{O})-$  is 0 or a positive number, and  $\text{R}_1$  is a hydrocarbon group.). X is the residual group of the organic compound having two active hydrogen groups and  $\text{R}_2$  is a dicarboxylic acid compound residual group or a residual group of a diisocyanate compound.],

and the second objective of a method for the manufacture of the recording sheet characterized by the fact that it is provided with a process for the preparation of a sheet-shaped base material and a process for the preparation of a recording layer-forming material with a water-soluble polymer compound constituted from the repeating unit represented by the general formula (1) mentioned above as the major component, a recording layer consisting of the recording layer-forming material is formed on the sheet-shaped base material side mentioned above, and at least one of electrodissociating radiation rays and active light is radiated onto the recording layer side mentioned above.

[0006]

#### Operation

In other words, the present inventors, in order to obtain a recording sheet that has a vivid and high density printed picture surface and is free from the soaking of the printed picture surface even under a high humidity atmosphere or the thickening of the surface, have accumulated research in regard to a variety of compounds with the forming material for the formation of the recording layer of this recording sheet as the center. As a result, if a recording layer-forming material consisting of a special water-soluble polymer compound with the constitution represented by the general formula (1) mentioned above is used, a recording layer is formed with this forming material and, furthermore, at least one of electrodissociating radiation rays and active light is radiated on the recording layer, the water-soluble polymer compound mentioned above is crosslinked and becomes water-insoluble. The formation of a highly water-absorbing resin is ascertained. If the recording sheet provided with a recording layer obtained by changing it from being water soluble to highly water absorptive is used, the expected objective can be achieved and the present invention has been accomplished.

[0007]

Next, the present invention will be explained in detail.

[0008]

The recording sheet of the present invention is constituted from a sheet-shaped base material and a recording layer formed on the surface of the sheet-shaped base material mentioned above.

[0009]

As the sheet-shaped base material mentioned above, there are no special restrictions. The conventional publicly known materials, such as base materials made of paper used for recording paper or the like, base materials made of polymer materials for OHP (overhead projector) sheets and so on can be mentioned.

[0010]

As the base materials made of paper, materials manufactured by publicly known methods by the addition of, if necessary, a mechanical pulp, a semi-mechanical pulp, a starch, a polyacrylamide resin or its derivatives, a melamine-formaldehyde resin, a urea-formaldehyde resin, or other paper strength reinforcing agents, strengthened rosin synthetic polymer type or alkyl ketene dimer or other sizing agents, sulfate alum or other fixing agents, talc, clay, heavy calcium carbonate, light calcium carbonate, aluminum hydroxide, natural or synthetic silicate, titanium oxide or other inorganic fillers, powdered urea-formaldehyde resin or other organic fillers into Northern bleached kraft pulp (NBKP), Northern bleached sulfite pulp (NBSP), broadleaf tree bleached kraft pulp (LBKP), hardwood bleached sulfite pulp (LBSP), or other bleached chemical pulps and so on can be mentioned. Furthermore, in the

materials manufactured in the manner mentioned above, if necessary, oxidized starch, and other paper strength reinforcing agents added externally can also be used. In regard to the composition of the base materials made of paper, there are no special restrictions.

[0011]

In the base materials made of polymer materials mentioned above, for example, as the base films, ordinary polyester films of the polyethylene terephthalate type or the like can be used. Furthermore, by the consideration of adhesion characteristics with special water-soluble polymer compounds as the recording layer-forming materials, films produced by mixing of a variety of polymers of other types can also be used, or the films produced by copolymerization with polymers of other types can also be used. /4 Furthermore, it is also possible that the surface of the films mentioned above be subjected to surface treatment with a chemical agent, oxidative treatment with gas flames, treatment with corona electric discharge or the like for improving the adhesion characteristics with the recording layer for use.

[0012]

Furthermore, other transparent films, such as those of polyolefin, polyamide, polyesteramide, polycarbonate or other common ones, can all be used.

[0013]

The recording layer-forming material formed on the surface of the base material mentioned above has a special water-soluble polymer compound as a major component. The water-soluble polymer compound is constituted by the repeating unit represented by the following general formula (1). After the formation of the recording layer by using the forming material mentioned above and by the radiation

of at least one of electrodissociating radiation rays and active light for crosslinking, the characteristics are changed from water solubility to water absorptivity. In the present invention, the major component has a meaning that includes the case of the major component alone as well.

[0014]

[Structure 4]



[In the formula (1), A is a unit constituted by the repeating unit of  $\text{---} (\text{CH}_2 \text{---} \overset{\text{R}_1}{\text{CHO}}) \text{---}$  (where  $-(\text{CH}_2\text{CH}_2\text{O})-$  mentioned above in A is present at at least 70 wt%, the number of repetitions is a positive number, the number of repetitions of  $-(\text{CH}_2\text{CHR}_1\text{O})-$  is 0 or a positive number, and  $\text{R}_1$  is a hydrocarbon group.). X is the residual group of an organic compound having two active hydrogen groups and  $\text{R}_2$  is a dicarboxylic acid compound residual group or a residual group of a diisocyanate compound.]

[0015]

It is preferable that  $\text{R}_1$  in the formula (1) mentioned above be especially a methyl group, an ethyl group, or a propyl group. Furthermore, it is preferable that the weight-average molecular weight of the water-soluble polymer compound mentioned above be at least 50,000. The weight-average molecular weight is more preferably 50,000-300,000, especially preferably 100,000-200,000. Such a specific water-soluble polymer compound can be obtained by using, for example, the two components shown in the following, (A) and (B).

(A) A polyoxyalkylene polyol with a weight-average molecular weight of at least 1000 produced by the addition polymerization of an alkylene oxide with ethylene oxide as a major component in an organic compound having two active hydrogen groups.

(B) At least one of a dicarboxylic acid compound and a diisocyanate compound.

[0016]

As the organic compound having two active hydrogen groups of (A) mentioned above, mainly ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, 1,4-butanediol, 1,6-hexanediol, neopentyl glycol, bisphenol A, polytetramethylene glycol, cyclohexane-1,4-dimethanol or other alicyclic diols, butylamine, octylamine, laurylamine, cyclohexylamine, aniline or other amines can be mentioned. These can be used alone or in combination.

[0017]

Furthermore, as the alkylene oxide containing ethylene oxide for addition polymerization into the organic compound having two active hydrogen groups mentioned above, ethylene oxide alone, an alkylene oxide mixture of propylene oxide, butylene oxide, styrene oxide, and so on with ethylene oxide alone as the major component can be mentioned. It is preferable that the content of the ethylene oxide mentioned above be at least 50 wt% (to be abbreviated to "%" hereafter) of the alkylene oxide as a whole. In other words, if the content of the ethylene oxide is less than 50%, the polymer compound obtained will be difficultly water-soluble. Furthermore, it is poor in the coated film-forming characteristics. It is impregnated in paper in the manufacturing method of the present invention. A coated film low in strength is formed during coating. These are inconveniences.

[0018]

(A) mentioned above can be obtained by using various components mentioned above, reacting by using, for example, sodium hydroxide, potassium hydroxide or other caustic alkali as a catalyst, at a

temperature of about 90-200°C for a reaction time of 2-30 h, and causing the addition polymerization of an alkylene oxide containing ethylene oxide into an organic compound having two active hydrogen groups in a block or random manner.

[0019]

For the polyoxyalkylene polyol (A) obtained by using the various components mentioned above, the weight-average molecular weight is preferably at least 1000, especially preferably 5000-30,000. In other words, if the weight-average molecular weight is less than 1000, the addition ratio of the crosslinking agent of the dicarboxylic acid compound and the diisocyanate compound of the corresponding (B) mentioned above is increased. Thus, a tendency in which dissolution characteristics with respect to water are decreased is observed.

[0020]

As the dicarboxylic acid compound in (B) for reaction with (A) mentioned above, a dicarboxylic acid, a dicarboxylic acid anhydride, and a lower alkyl ester of a dicarboxylic acid can be mentioned. As the dicarboxylic acid mentioned above, phthalic acid, isophthalic acid, terephthalic acid, malonic acid, succinic acid, sebacic acid, maleic acid, fumaric acid, adipic acid, itaconic acid, and so on can be mentioned. As the dicarboxylic acid anhydride mentioned above, anhydrides of a variety of dicarboxylic acids can be mentioned. Furthermore, as the lower alkyl ester of a dicarboxylic acid mentioned above, a methyl ester, a dimethyl ester, an ethyl ester, a diethyl ester, a propyl ester, a dipropyl ester, and so on can be mentioned. These can be used alone or in combination.

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[0021]

As the diisocyanate compound in (B) mentioned above, specifically, tolylene diisocyanate, diphenylmethane diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, xylene diisocyanate, 4,4-methylene-bis(cyclohexyl isocyanate) and so on can be mentioned.

[0022]

The water-soluble polymer compound as the major component of this recording layer-forming material can be obtained by the reaction in the following manner by using (A) and (B) mentioned above. First of all, a description will be given in regard to the case in which (B) is a dicarboxylic acid compound. In other words, it can be obtained by preparing (A) mentioned above, after the addition of (B) mentioned above into this, heating, and carrying out dehydration or alcohol removal under heating at 80-250°C and under a reduced pressure of 0.001-20 mm Hg. The reaction time during this period is generally 30 min to 10 h.

[0023]

The blending ratio (A/B) of both during the reaction of (A) and (B) mentioned above is, specifically, in the equivalent ratio, preferably set in the range of A/B = 1/0.5 – 1/3.5.

[0024]

Next, a description will be given in regard to the case in which (B) mentioned above is a diisocyanate compound. In other words, the urethane formation reaction in the case of the diisocyanate compound is carried out, for example, by mixing the polyoxyalkylene polyol and the diisocyanate compound so that the blending ratio as the NCO/OH equivalent ratio is in the range of 0.5-1.5, and reacting at 80-150°C

for 1-5 h. In the urethane formation reaction, dibutyltin dilaurate or other publicly known catalysts can also be used.

[0025]

The weight-average molecular weight of the water-soluble polymer compound obtained in this manner, as described before, is set preferably to at least 50,000, more preferably, 50,000-300,000, especially preferably, 100,000-200,000. In other words, if the weight-average molecular weight is less than 50,000, the dissolution rate with respect to water is high but the water absorption rate is small and it is difficult to satisfy the desired conditions. Furthermore, the mechanical properties of the coated film formed are poor and the performance as the recording sheet is damaged. Furthermore, if the weight-average molecular weight is at least 300,000, there is a tendency in that the viscosity of the aqueous solution is increased and coating with respect to the base material is no longer easy. Furthermore, the ethylene oxide chains are contained at at least 50% in this water-soluble polymer compound. Since the ethylene oxide chains are contained at at least 50%, it is a material having water solubility and water dispersibility.

[0026]

In the recording layer-forming material mentioned above, in addition to the special water-soluble polymer compound, if necessary, other additives, such as aqueous solutions of oxidized starch, polyvinyl alcohol, polyacrylamide, methylcellulose, hydroxyethyl cellulose, carboxymethylcellulose, hydroxypropylcellulose or other polymers, heavy calcium carbonate, light calcium carbonate, talc, kaolin, aluminum hydroxide, synthetic silicate or other pigments, glycerol or other plasticizing agents can also be blended appropriately.

[0027]

The recording sheet of the present invention can be manufactured in the following manner, for example. In other words, first of all, a sheet-shaped base material is prepared. On the other hand, the special water-soluble polymer compound and, if necessary, other additives are blended appropriately, dissolved in water to prepare an aqueous solution with the water-soluble polymer compound as the major component (the recording layer-forming material). Next, on top of the sheet-shaped base material mentioned above, the aqueous solution with the water-soluble polymer compound mentioned above as the major component is coated. It is then dried to form a recording layer on the surface of the base material. Next, by the radiation of at least one of the electrodissociating radiation rays and active light on the surface of the recording layer mentioned above, the water-soluble polymer compound mentioned above is crosslinked and the recording layer is changed to become water absorptive. The recording sheet as the objective can be manufactured in this manner. It is preferable that the thickness of the coating mentioned above be set at 5-30  $\mu\text{m}$  (as solid). In the case in which it is necessary to consider the transparency of the OHP sheet for the sheet-shaped base material, the usage of a pigment as another additive is undesirable because of the occurrence of the scattering of light. Thus, coating is carried out by using an aqueous solution with the water-soluble polymer compound as the major component with the removal of the pigment mentioned above.

[0028]

It is preferable that the concentration of the aqueous solution with the water-soluble polymer compound mentioned above as the major component be set in the range of 1-20% for ease in the coating process and so on. Furthermore, it is also acceptable to carry out coating by division into two layers so

that the previously mentioned other additives only are undercoated and the aqueous solution of the water-soluble polymer compound is coated on the top. As the coating method mentioned above, there are no special restrictions. The conventional publicly known methods, such as blade, air knife, roll coater or other coating machines can be used. A size press can also be used.

[0029]

In the recording sheet manufactured in this manner, by the partial crosslinking of the special water-soluble polymer compound mentioned above, it is changed from being water soluble to water absorptive. In other words, if the partial crosslinking is carried out, while the crosslinked portion is maintaining hydrophilicity and the water absorptivity of the ink is good, the effect of rapid drying after printing is achieved while the effluence and color mixing of inks of different colors are being controlled.

[0030]

As the electrodissociating radiation rays for radiation on the surface of the recording layer mentioned above, for example,  $\gamma$  rays, electron beams, X rays and so on can be mentioned. Furthermore, as the active light mentioned above, ultraviolet rays and so on can be mentioned. As the radiating conditions of the  $\gamma$  rays and electron beams as the electrodissociating radiation rays mentioned above, it is preferable that the radiation dose be in the range of 1-20 Mrad. In other words, if the radiation dose is less than 1 Mrad, the crosslinking of the water-soluble polymer compound will be insufficient. If it is more than 20 Mrad, the degree of crosslinking is increased and the water absorbing performance as the objective cannot be achieved. In addition, the molecular cutoff of the water-soluble polymer compound and, in the case of using the water type base material as the sheet-shaped base material, the molecular cutoff of the cellulose as the major component of paper occur, and a tendency in which the strength is

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decreased is observed. On the other hand, as the irradiating conditions of the active light mentioned above, it is preferable to set the wavelength at 254 nm or less. As long as the characteristics of the highly water absorptive resin are changed by the crosslinking of the water-soluble polymer compound also including the electrodissociating radiation rays, there are no special restrictions.

#### [0031]

In the recording sheet of the present invention, as the formation embodiment of the recording layer, of course, the embodiment of the two-layer structure by the provision of the recording layer on the surface of the base material, as described above, the embodiment in which the recording layer is constituted by two layers of the undercoating layer and the upper coating layer, and the embodiment of providing the recording layer on the surface of the base material and impregnating the recording layer-forming material in the base material can be mentioned.

#### [0032]

##### Effect of the invention

As described above, in the present invention, on the sheet-shaped base material, the recording layer is formed with the water-soluble polymer compound constituted from the repeating unit represented by the general formula (1) given above as the major component. Then, by the radiation of at least one of electrodissociating radiation rays and active light on the surface of the recording layer mentioned above, the water-soluble polymer compound mentioned above is partially crosslinked and a recording sheet with the recording layer changed to be water absorbing is obtained. Thus, the recording layer having the water absorptivity mentioned above is excellent in wetting characteristics for ink and is improved in absorptivity from the characteristics that this layer-forming material itself has. As a result, dirtying due

to color mixing or scattering of inks of different colors and flowing out does not occur. Furthermore, under a high humidity atmosphere, there is no soaking of the printed picture surface or thickening of the picture surface. Thus, for example, for the color copy or the like by the inkjet mode using the recording sheet of the present invention, a picture image that is obtained with difficulty with a conventional recording sheet, that is, a picture image with a high picture image density and a vivid color tone can be obtained.

[0033]

Next, an explanation will be given in reference to application examples together with comparative examples.

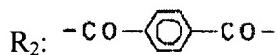
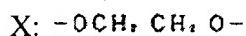
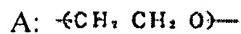
[0034]

Application Example 1

As the base material made of paper, 90 parts by weight (to be abbreviated to "parts" hereafter) of LBKP and 10 parts of NBKP were stirred. To this, 7 parts of talc, 0.6 part of rosin, and 2.2 parts of sulfate alum were added. Papermaking was carried out with a long screen papermaking machine to a basis weight of 65 g/m<sup>2</sup>. Next, by using oxidized starch, size pressing was conducted to prepare coated raw paper. On the other hand, with ethylene oxide alone in ethylene glycol, the addition polymerization was carried out to prepare polyethylene glycol (molecular weight 12,000). Next, to 100 parts of this polyethylene glycol, 1.86 parts of dimethyl terephthalate was added and the ester exchange reaction was conducted to prepare a water-soluble polymer compound with a molecular weight of 130,000 (in the repeating unit represented by the general formula (1) given above, A, X and R<sub>2</sub> are as follows).

[0035]

[Structure 5]



[0036]

By obtaining a 20% aqueous solution with water by using this water-soluble polymer compound, the 20% aqueous solution mentioned above was coated on the surface of the base material made of paper mentioned above, so that the thickness was 10 µm by using an air knife coater, and dried to form a coated film (drying conditions: 100°C x 2 h). Next, by carrying out irradiation with electron beams on this coated film at a radiation dose of 5 Mrad, the water-soluble polymer compound was partially crosslinked to yield the objective recording sheet.

[0037]

#### Application Example 2

Coated raw paper was prepared in the same manner as in Application Example 1. On the other hand, propylene oxide and ethylene oxide were subjected to addition polymerization in ethylene glycol to prepare polyethylene polypropylene glycol (ethylene oxide 85%, propylene oxide 15%, and molecular weight 20,000). In 100 parts of this polyethylene polypropylene glycol, 1.09 parts of diphenylmethane diisocyanate was added, and the reaction was carried out at 85°C for 90 min to prepare a water-soluble polymer compound with a molecular weight of 110,000 (in the repeating unit represented by the general formula (1) given above, A, X and R<sub>2</sub> are as follows).

[0038]

[Structure 6]

A: A unit constituted from the repeating units of  $\text{CH}_2$ ,  $\text{CH}_2\text{O}$ — and  $\text{CH}_2\text{C}(\text{H}_2)\text{O}$ —

X:  $-\text{OCH}_2\text{CH}_2\text{O}-$

$R_2: -\text{NHCO}-\text{C}_6\text{H}_4-\text{CH}_2-\text{C}_6\text{H}_4-\text{NHCO}-$

[0039]

By obtaining a 20% aqueous solution with water by using this water-soluble polymer compound, the 20% aqueous solution mentioned above was coated on the surface of the base material made of paper mentioned above so that the thickness was 10  $\mu\text{m}$  by using an air knife coater, and dried to form a /7 coated film (drying conditions: 100°C x 2 h). Next, by carrying out irradiation with  $\gamma$  rays on this coated film at a radiation dose of 5 Mrad, the water-soluble polymer compound was partially crosslinked to yield the objective recording sheet.

[0040]

#### Application Example 3

Coated raw paper was prepared in the same manner as in Application Example 1. On the other hand, in 100 parts of this polyethylene polypropylene glycol (ethylene oxide 85%, propylene oxide 15%, and molecular weight 20,000) obtained in Application Example 2, 1.33 parts of dimethyl sebacate was added, and the ester exchange reaction was carried out to prepare a water-soluble polymer compound with a molecular weight of 150,000 (in the repeating unit represented by the general formula (1) given above, A, X and  $R_2$  are as follows).

[structure 7]

A: A unit constituted from the repeating units of  $\text{CH}_2\text{CH}_2\text{O}$ — and  $\text{CH}_2\text{CHO}$ —

X:  $-\text{OCH}_2\text{CH}_2\text{O}-$

R<sub>2</sub>:  $-\text{OC}(\text{CH}_3)_2\text{CO}-$

[0042]

By obtaining a 20% aqueous solution with water by using this water-soluble polymer compound, the 20% aqueous solution mentioned above was coated on the surface of the base material made of paper mentioned above, so that the thickness was 10  $\mu\text{m}$  by using an air knife coater, and dried to form a coated film (drying conditions: 100°C x 2 h). Next, by carrying out irradiation with  $\gamma$  rays on this coated film at a radiation dose of 10 Mrad, the water-soluble polymer compound was partially crosslinked to yield the objective recording sheet.

[0043]

#### Application Example 4

A polyester film with a thickness of 100  $\mu\text{m}$  [HS grade (an untreated product)] was used instead of the base material made of paper. On the other hand, by using the water-soluble polymer compound prepared in Application Example 1 described above, this was dissolved in water to obtain a 10% aqueous solution. Using a bar coater, by coating and drying so that the thickness was 100  $\mu\text{m}$ , a coated film was formed (drying conditions: 100°C x 2 h). Next, by carrying out irradiation with electron beams,

on this coated film at a radiation dose of 10 Mrad, the water-soluble polymer compound was partially crosslinked to yield the objective recording sheet.

[0044]

Application Example 5

The water-soluble polymer compound prepared in Application Example 2 described above was used instead of the water-soluble polymer compound prepared in Application Example 1. Furthermore, the irradiation was carried out with  $\gamma$  rays (radiation dose of 15 Mrad) instead of the electron beams. The rest was the same as in Application Example 4 for the preparation of a recording sheet with the formation of the recording layer with a thickness of 10  $\mu\text{m}$ .

[0045]

Application Example 6

The water-soluble polymer compound prepared in Application Example 3 described above was used instead of the water-soluble polymer compound prepared in Application Example 1. Furthermore, the irradiation was carried out for 30 min with a low-pressure mercury lamp (254 nm) instead of the electron beams. The rest was the same as in Application Example 4 for the preparation of a recording sheet with the formation of the recording layer with a thickness of 10  $\mu\text{m}$ .

[0046]

Comparative example

Polyvinyl alcohol (degree of polymerization 500, and degree of saponification 82%) was used instead of the water-soluble polymer compound prepared in Application Example 1. The rest was the same as in

Application Example 4 for the preparation of a sheet with the formation of the coated film (recording layer) with a thickness of 10 µm. However, the coated film (polyvinyl alcohol) of this sheet peeled off immediately from the polyester film.

[0047]

By using the products of the application examples and the product of the comparative example described above, color copying was carried out using the ordinary inkjet mode. In regard to the sheets obtained, the absorptivity of multicolor ink, the degree of vividness of the copy picture image, the flowing out of multicolor ink, and the presence or absence of thickening on the copy picture surface under a high humidity atmosphere were observed and evaluated. The results are shown in Tables 1 and 2 to be provided later. The various characteristics mentioned above were evaluated by the following methods.

[0048]

Absorptivity of multicolor ink

The degree of vividness of the picture image during printing of the dot 3 times in the same portion was judged visually. The results were represented by O for obtaining a vivid picture image, and X for obtaining a non-vivid picture image.

[0049]

Degree of vividness of the copy picture image

The degree of vividness of the color of the recorded picture image using the inkjet mode was judged visually. The results were represented by O for obtaining a vivid picture image, and X for obtaining a non-vivid picture image.

[0050]

Flowing out of multicolor ink

The dot was printed 3 times in the same portion, and the results were observed visually. They were represented by X for the observation of the flowing out of multicolor ink on the surface of the recorded material (recording sheet), and O for no observation of this.

[0051]

Thickening on the copy picture surface under a high humidity atmosphere

The recording sheets after carrying out the color copying using the inkjet mode were placed in under an atmosphere at 30°C x 95% relative humidity for 24 h. Afterwards, the surface of the recording sheet was touched with fingers. The results were represented by X for having a tacky feeling and O for having no tacky feeling.

[0052]

TABLE 1

	(1) 実施例					
	1	2	3	4	5	6
(2)	インク吸収性	○	○	○	○	○
	鮮明度	○	○	○	○	○
	流れ出しの有無	○	○	○	○	○
	べとつきの有無	○	○	○	○	○

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Key: 1 Application Example

2 Ink absorptivity

Degree of vividness

Presence or absence of flowing out

Presence or absence of thickening

[0053]

TABLE 2

	(1) 実施例		(2) 比較例
	7	8	
(3)	インク吸収性	○	○
	鮮明度	○	○
	流れ出しの有無	○	○
	べとつきの有無	○	○

- Key:
- 1 Application Example
  - 2 Comparative Example
  - 3 Ink absorptivity
    - Degree of vividness
    - Presence or absence of flowing out
    - Presence or absence of thickening

[0054]

From the results of Tables 1 and 2 given above, the products of the application examples were all excellent in ink absorptivity, high in the degree of vividness, and free of the occurrence of flowing out and thickening of the multicolor ink. In contrast to these, the product of the comparative example, because of the poor adhesiveness with respect to the polyester film, could not be used as a recording sheet. Furthermore, in order to use it as a sheet, not only was an adhesive layer required, but also the color mixing and flowing out of the multicolor ink were observed because of a low ink absorption rate.